LINOTYPE
INSTRUCTION
BOOK

Micro-Therm

Electric Pot

(COMET TYPE)

MERGENTHALER LINOTYPE COMPANY · LINOTYPE ·

A Division of ELTRA Corporation

Introduction

The Micro-Therm Electric Pot designed for high speed casting was first introduced in 1950 for use on the first high speed Comet Linotype. It was referred to as the Comet Type Electric Pot, Type C-4.

In 1959, certain improvements were made to this electric pot and it became known as the Universal Comet Type Electric Pot. It was made available with either the Microtherm Temperature Controls or the Linotronic Temperature Controls, and became known as Type G.

The Universal Comet Type Electric Pot has been standard equipment on new Linotype machines since 1959, including the Elektron which has a speed capability of 15 lines per minute.

This instruction booklet covers the Comet Type Electric Pot Type C-4 with Microtherm Controls. It can be used, however, for the Universal Comet Type Electric Pot. If the electric pot is equipped with Linotronic Controls, use Service Instruction No. 18-1, in addition.

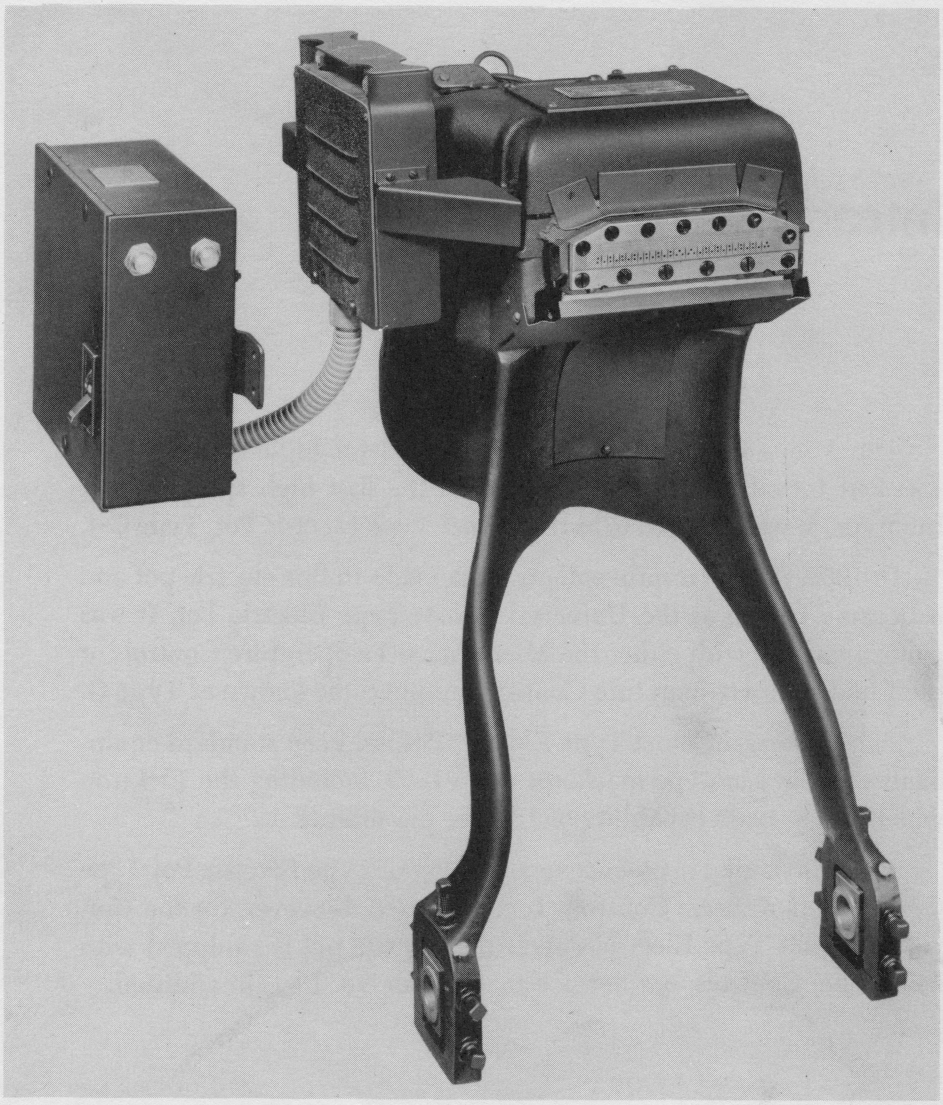

FIGURE 1 – Comet Type Micro-Therm Electric Pot and Controls

Table of Contents

List of Illustrations

1. General Description

Physical Components

The physical components which are characteristic of the Comet Type Electric Pot are:

1. The Pot Cover and Crucible—These are substantially the same as on previous models. The crucible assembled with mouthpiece, Fig. 9, fits inside of the pot jacket and is held securely in place by projecting lugs which slide into corresponding recesses in the pot jacket. The space between the crucible and pot jacket is entirely filled with "dry" asbestos to insulate the crucible, except for the front portion where the throat heaters and "Klixon" switch are located. Fastened to lower side, near throat of crucible, is the "Klixon" switch 4, Fig. 13, for protection against over-heating of pot.

In each leg of the pot jacket there is a square bushing through which the vise frame shaft runs. These bushings are held in place in the leg on four sides by adjusting screws which allow the bushing to "float" in the leg when an adjustment is made to level the pot by turning the screws.

The pot cover completely covers the crucible and heaters and it is held in place by four screws. A splash guard prevents splashes of metal (due to overfilling the crucible with type metal) from reaching and shorting the heater terminals. The inside of the cover is packed with heat insulating asbestos cement to prevent loss of heat into the room. The pot cover lid is hinged and provided with a handle so that it may be easily opened for insertion of metal pigs into the crucible or for inspection. When an automatic metal feeder is used, this cover is either kept open or removed.

2. The Crucible Throat—The crucible throat is designed to assure a positive contact between the surface of the throat and the cast-in-aluminum heater blocks. A machining cut in the crucible back of the mouthpiece accommodates the mouthpiece sensing bulb 24, Fig. 9.

3. The Heaters—These are the Lino-Therm tubular type and four are used: two in the crucible and one each in the cast-in-aluminum block throat heaters, Fig. 9.

Each of the four heaters consists of a length of steel tubing, Fig. 8, enclosing spirally wound nickel chromium resistance wire, which is surrounded by a special insulation of magnesium oxide. For detailed description of heaters, see section under "Lino-Therm Heaters."

4. The Pot Jacket—To provide clearance and accessibility to the lower throat heater a portion of the jacket has been cut away. See Fig. 2. This permits replacement of the lower throat heater without removing crucible from pot jacket. A sheet metal cover is held over this "T" cut by three screws, Fig. 2.

5. Mouthpiece—Fastened to the throat of the crucible by 13 screws is the mouthpiece. The standard mouthpiece for the Comet type pot is a flat piece of metal with a row of holes (corresponding to location of the body portion of the slug) through which the metal enters the mold.

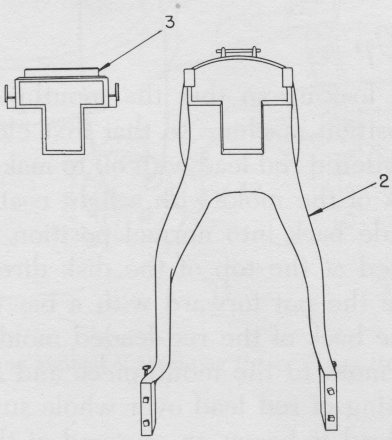

FIGURE 2—View of Pot Jacket and Lower Throat Heater Terminal Cover

6. Micro-Therm Temperature Control—This consists of a control box, Fig. 3, mounted on the side of the pot; a relay and switch box, Fig. 5, mounted on the mold gear arm; a "Klixon" overheat switch 4, Fig. 13, mounted on the side of crucible; interconnecting wire leads and conduits, and the two temperature sensing bulb and bellows 23, Fig. 9, plus two snap-action switches, 41, 42, Fig. 3.

NOTE: It is of the greatest importance that the serial number and type of the pot be specified on correspondence dealing with maintenance or replacement of the pot or its component parts. Also electrical characteristics of the power supply should be specified.

2. Installation

The Comet Type Electric Pot and control box is shipped completely assembled and wired. The complete electric pot equipment includes the pot jacket, crucible and mouthpiece control box, the relay and switch box, a pot pump plunger, two pot leg bushings, two temperature control adjusting screw wrenches and an instruction sheet. Connecting wire conduits between Relay Box and Control Box are provided. However, customer is responsible for power line conduit to master power switch and is also responsible for proper fusing of the circuit external to the pot.

Pot Lock-Up

To make the pot lock-up so that the mouthpiece will be square with the mold, position machine so that first elevator rests on vise cap. Mix some powdered red lead with oil to make a paste and with a rag cover the back of the mold with a light coating of the mixture. Push the mold slide back into normal position with the mold that has been red-leaded at the top of the disk directly in front of the mouthpiece. Force the pot forward with a bar so that the mouthpiece is against the back of the red-leaded mold. The red lead will transfer from the mold to the mouthpiece and a good lock-up will show an even coating of red lead over whole surface of the mouthpiece. If the red lead is heavy on one end of the mouthpiece and there is none on the other, adjust the screws in the pot legs to compensate for this until a good lock-up is made. After the proper adjustment is secured tighten the lock nuts on the adjusting screws.

Mouthpiece Alignment to Follow Pot Lock-Up

The holes in the mouthpiece should be made to line up just above the edge of the mold body, so that they will be in the center of a 5-point slug. This adjustment, if pot mouth aligning gauge F-550 is used, is made by turning the machine until the first elevator is in its lowest position, at which point the vise should be opened, the mold removed, and the gauge placed between the vise jaws.

If you do not have the gauge, remove the mold cap, so that the location of the mouthpiece holes can be carefully watched. Raise the first elevator, blocking it up with a piece of wood, one end of which should rest upon the upper end of the vise automatic stop rod. Close the vise, unlock the mold cam lever and move the mold disk forward by hand so that the studs will enter the bushings.

When the pot mouth aligning gauge is used, have the two lugs in the gauge resting on the seat of the mold pocket in the disk and turn the machine by hand until the mouthpiece advances to within one-quarter of an inch of the gauge. Force the pot forward against the gauge, using a bar at the back.

If using the mold as a gauge, proceed in the same way and bring the mouthpiece up by hand against the mold, raise or lower the pot so lower edge of mouthpiece holes are in line with top of gauge or mold body, by using the top and bottom adjusting screws in the pot legs, being careful to bring the end holes inside of 30-em liners in the mold. When correct position is secured, tighten up the lock nuts.

Conduit and Wire Connections

After fastening the relay box, Fig. 5, to the mold gear arm, the connections between the relay box, Fig. 5, and the control box, Fig. 3, can be made. There is a six-wire flexible conduit protruding out of the control box on the electric pot and with the use of wiring diagram, Fig. 6, the proper connections can be made in the relay box. Use the hole in the bottom of the relay box housing to pass conduit into relay box.

Connection to Power Source

All Linotype Pots are single phase and are connected to the power source by two wires running to the power switch terminals in the relay box, Fig. 5. Running these two wires from the machine to some fused panel should be done by a licensed electrician who knows the local wiring code.

Phase

The Comet Type Pot in all cases is two-wire. On a single-phase circuit, connect direct to two wires of the circuit. On a two-phase circuit,

the pot is connected to two wires of one phase only, the two wires of the other phase being disregarded entirely. Where several pots are used, the phases can be balanced, by connecting to alternate phases. On a three-phase circuit, the pot is connected to any two of the three wires of the circuit and the phases may be balanced in the same manner as for two-phase current. In cases where a four-wire, three-phase circuit exists, connect the pot to any two of the phase wires for 200-230 volts and to any one of the three-phase wires and the neutral wire for 110-125 volts.

On a two-wire direct current circuit, connect direct to both wires. On a three-wire direct current circuit of 220 volt power source, connect to the two hot wires for 220 volt equipment and to one of the hot wires and the neutral wire for 110 volt equipment.

After all connections are completed and the proper fuses installed in the power supply line, a test should be made for grounds before turning the power switch on. A magneto or ohmmeter can be used for this purpose and the current should not be turned on until it is certain that the equipment is properly wired and free from grounds.

Nominal Power Rating

Each 30-em pot is rated at 2800 watts. However, wattage may vary between 1900 and 2900 watts depending on pot voltage. The ampere rating for 110 volt pots is 22.5 amperes. For 220 volt pots it is 11.50 amperes. The above values vary depending upon the voltage applied to the pot.

Although the Comet Type Electric Pot has a higher wattage rating than the previous Linotype Micro-Therm Electric Pot, it is just as economical to operate, since the heating cycle is of shorter duration. The total current consumption of the two pots compares very closely.

3. Operation

Adjusting the Micro-Therm Temperature Control

When the Comet Type Electric Pot is shipped from the factory, it is accurately adjusted and the adjustments should not be unnecessarily disturbed. If necessary to adjust, however, proceed as follows:

To adjust the temperature control, turn the master power switch 31, Fig. 5, to the "On" position. Both indicating lamps will light. Lamp at right will remain lighted as long as current flows to the throat heaters, while lamp at left will remain lighted as long as current flows to the crucible heaters.

After the metal has melted, insert a glass rod thermometer in the pot pump well. When the thermometer registers 535 degrees F., left-hand lamp should go out, indicating that current has been shut off to crucible heaters. If lamp does not go out, it will be necessary to turn adjusting dial 37, Fig. 3, toward "Cold" until it does go out.

If the 535 degrees F. marking on the dial 37, Fig. 3, does not coincide with the indicating line on top of the control box 35, loosen the two set screws which fasten the dial to the adjusting shaft 38, and turn dial 37 so that markings agree. Then tighten the two set screws. The crucible temperature control is now adjusted for 535 degrees F. To increase the temperature, turn dial toward "Hot"; to decrease temperature turn dial toward "Cold."

The adjusting screw 54, and lock nut 55, Fig. 3, are set correctly in the factory and this setting should not be disturbed unless it is absolutely necessary. When this factory setting of temperature is made, the adjusting dial shaft 38, is positioned so that it may be turned the same amount either toward "Hot" or "Cold." This gives the maximum temperature adjusting range.

Adjusting Switch Plunger Screw

If it becomes necessary to reset adjusting screw 54, Fig. 3, proceed as follows:

1. Turn adjusting dial 37, Fig. 3, to the point where it can move an equal distance either toward "Hot" or "Cold." Loosen two set

screws on the dial 37, and line up 535 degrees F. mark on dial with indicating line on top of crucible control box 35. Tighten set screw.

2. Turn power switch 31, Fig. 5, "On" and allow metal to heat up. Insert a glass rod thermometer in pot well. When temperature reaches 535 degrees F., lamp at left should go out indicating that the snap-action switch 42, Fig. 3, has shut off the current to the crucible heaters.

3. If the left-hand lamp does not go out at 535 degrees F., or goes out before the temperature reaches 535 degrees F., it will be necessary to change setting of adjusting screw 54. Two wrenches are provided for this purpose. Loosen lock nut 55 and turn adjusting screw 54 counter-clockwise (toward switch) to decrease temperature and clockwise (away from switch) to increase temperature. Tighten lock nut 55 securely when proper adjustment is reached.

The adjustments for mouthpiece control are made exactly as described for the crucible.

Initial Heating of Pot

When this equipment is shipped from the factory, the pot contains only a small amount of metal and the first step is to melt down sufficient metal to fill the crucible. At this first heating, standard ingots should not be used, but the pot should be filled by means of slugs or small flat pieces of type metal that will fit down in contact with the heaters. These will melt much quicker than ingots and with less possibility of overheating the crucible heaters which are not designed for operation in air, but which should be covered by metal at all times.

When the slugs are placed in contact with the crucible heaters 14, 15, Fig. 9, turn the power switch 31, Fig. 5, to the "On" position. This switch controls the current for both crucible and throat heaters. When the current is turned on, the two indicating lamps will immediately light. Crucible heater indicating lamp (left hand) will remain lighted only as long as current flows through the crucible heaters. Throat heater indicating lamp (right hand) will remain lighted only as long as current flows through the mouth and throat heaters.

About one hour will be required to melt down and bring the metal up to operating temperature. After the first melting down, however, the pot should heat up to operating temperature in about fifty minutes from the time of turning on the current.

Control Heating Cycle

When the metal in the crucible is cold and the power switch 31, Fig. 5, is turned to the "On" position, electrical current will flow through the crucible heaters 14, 15, Fig. 9, and also through the throat heaters 6, 7. Both the crucible and mouthpiece snap-action switches 42, 41, Fig. 3, are always in the closed position when the metal is cold. The passage of current through the crucible heater windings will heat the metal in the crucible. As the temperature of metal in the crucible rises, the non-volatile liquid in the sensing bulb will expand and force the plunger adjusting screw 54, Fig. 3, against the small swinging plate 46, and when the temperature reaches 535 degrees F., this movement of the bellows 53, will open the snap-action switch 42, which will in turn deenergize the relay 32, Fig. 5, causing it to open and breaking the heater circuit.

In a similar manner, the mouthpiece control snap-action switch 41, Fig. 3, will open when the mouthpiece has reached its proper operating temperature. After the crucible snap-action switch 42, Fig. 3, and relay 32, Fig. 5, opens and there is no longer current passing through the crucible heaters, the metal will start to cool. The liquid in the expansion unit will then contract, relieving the pressure on the snap-action switch 42, and the switch will snap to the "On" position, again actuating the relay 32, and closing the crucible heater circuit. This cycle is repeated as long as the power switch 31, Fig. 5, is left in the "On" position.

The crucible temperature control is normally set for operation at approximately 535 degrees F. This is found to give the best all around casting results for average type metal. If it is desired to change the operating temperature at any time, the dial 37, Fig. 3, can be turned counter-clockwise to increase temperature. The mouthpiece temperature control is normally set so that the mouthpiece temperature will be approximately 500 degrees F.

4. The Micro-Therm Temperature Control

The temperature of the metal in the crucible and the temperature at the mouthpiece are automatically controlled by the Micro-Therm Temperature Control. The Crucible Control and the Mouthpiece Control are independent controls; the only item in common being the master power switch 31, Fig. 5, located in the relay and switch box, which disconnects both controls from the power supply. This power switch has incorporated within it the circuit breaker feature to protect the pot against current overload and pot overheating. Each control unit is automatic in its action and adjustable for control within very narrow limits of temperature.

Description of Action

Each control unit contains an expansion bellows 53, Fig. 3, on the end of a capillary tube 23, leading from a bulb 24, Fig. 9, placed where the temperature is to be controlled. These parts, assembled together and entirely filled with a non-volatile fluid, hermetically sealed in, form a thermal expansion system in which a rise in temperature expands the bellows 53, to cause a plunger 54 at its end to press against a small lever 46, breaking the electrical contact in a very sensitive snap-action switch 42. A lowering of the temperature at bulb causes the bellows to contract sufficiently to allow a spring contact within the snap-action switch to act again and close the electric circuit to the heaters.

The bulb and bellows assembly used for both crucible and mouthpiece controls are the same, but the tubes are bent to the required contours for each application.

Type of Control

This type of control is known as the On-and-Off type of control. If the metal temperature in the crucible is below a preset point, the power is turned on full to the heaters until the temperature reaches

this point. Then the power is turned completely off. The temperature of the metal now falls slowly to the low point and at this point the power is turned on full again. Thus the power is either on full or completely off. There must, of course, be a slight difference between the point where the power is turned on and the point where the power is turned off. This is known as Temperature Differential. Because of the sensitiveness of the bulb and bellows and snap-action switch, this differential can be made very small. The control box contains the following components: fine adjustment unit for crucible temperature, fine adjustment unit for mouthpiece (these two units are back to back at top of control box), terminal strip 50, Fig. 3, two manually-operated adjusting dials 36, 37, a sheet metal strip guard 40, over the dials 36, 37, and a control box cover which is removed by operating a quick one-half turn fastener and lifting cover off two holding studs.

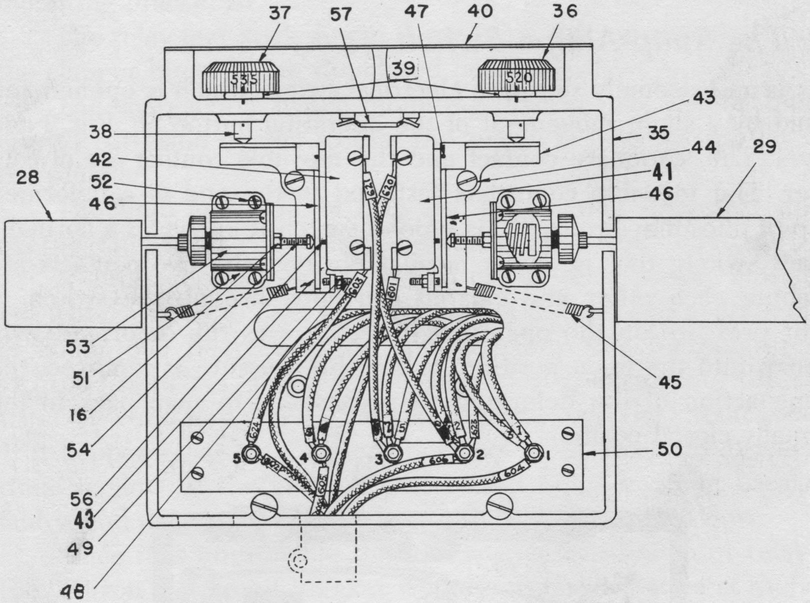

FIGURE 3—View of Comet Micro-Therm Electric Pot Control Box

The Crucible Temperature Control
The Heat Sensitive Element

This consists of a steel bulb 25, Fig. 9, which is immersed in the type metal in the crucible. This bulb is connected by a capillary tube 23 to a bellows and is completely filled with a non-volatile liquid with a high coefficient of thermal expansion. A rise in temperature of the type metal causes this liquid to expand which results in a forward movement of the base of the bellows. One end of a plunger is held against the base of the bellows by a spring. The purpose of the spring and plunger is to assure the bellows contracting when the heat is reduced and the liquid in bulb and bellows unit contracts. An adjusting screw 54, Fig. 3, is threaded into the other end of the plunger and held in place by a lock nut 55. The bellows and plunger are fastened by a bracket 51, to the inside of the control box by four small screws 52. A guard 28, is provided to protect the capillary tube from control box to crucible. Inside crucible, the bulb is held in place by a jacket 27, mounted on crucible wall.

The Snap-Action Switch

This is an extremely sensitive electrical switch which is opened and closed by a slight movement of the operating button 56, Fig. 3 and Fig. 4. The stationary contact and the movable contact are of coin silver. The movable contact is fastened to the end of a deformed strip of phosphor-bronze. This type of switch is known as a normally closed switch, that is, in its normal position the two contacts are touching each other and current can flow through the switch. A slight pressure on the operating button causes the deformed strip to snap into the open position. When the pressure is removed, the spring action of the deformed strip causes it to snap back to the normally closed position.

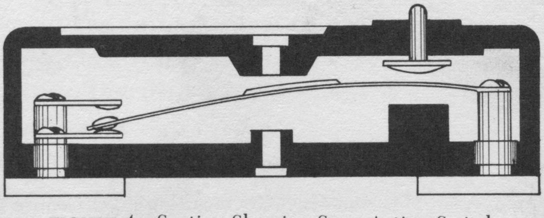

FIGURE 4—Section Showing Snap Action Switch

There are two snap-action switches used, one 42, Fig. 3, to control the crucible heater circuit and the other 41, Fig. 3, to control the throat heater circuit. They are mounted on separate brackets 43, in the control box.

Each bracket pivots on a stud 44, and the adjusting shaft 38, moves the bracket and switch to or from the bellows plunger adjusting screw 54, as the control dial 36, or 37, is turned to increase or decrease the heat. A spring 45, attached to each bracket 43, permits the bracket to pivot away from the bellows plunger adjusting screw 54, in the event of over expansion of the bellows, in order to prevent damage to the switch 41 or 42, Fig. 3.

The swinging plate 46, Fig. 3, transmits the movement of the bellows plunger adjusting screw 54 to the switch operating pin 56.

Micro-Therm Mouthpiece Sensing Bulb

A machining cut in back of the mouthpiece provides for greater contact area between the sensing bulb and mouthpiece. The heater block 6, Fig. 14, is designed with an angular face which tends to force the sensing bulb down firmly behind the mouthpiece.

Action of Adjusting Dials

The temperature adjustment for the crucible metal consists of a round dial 37, Fig. 3, fastened to upper end of the adjusting shaft 38, by two set screws. When the dial is turned to the right, or clockwise, the shaft moves downward forcing the snap-action switch 42, and its bracket 43, away from the plunger 54. This permits the temperature of the type metal to rise higher before the plunger 54 moves to open the switch 42, and shut off the current. When the dial 37 is turned to the left, or counter-clockwise, the shaft 38 rises, thus permitting the switch to move closer to the plunger and decreasing the operating temperature. The operating principle is the same for the mouth and throat heat control dial.

The Power Relay

This is an electrically-operated heavy duty magnet switch 32, Fig. 5, capable of handling the heater current for many years. This consists of a heavy silver contact mounted on a pivoted arm which is drawn

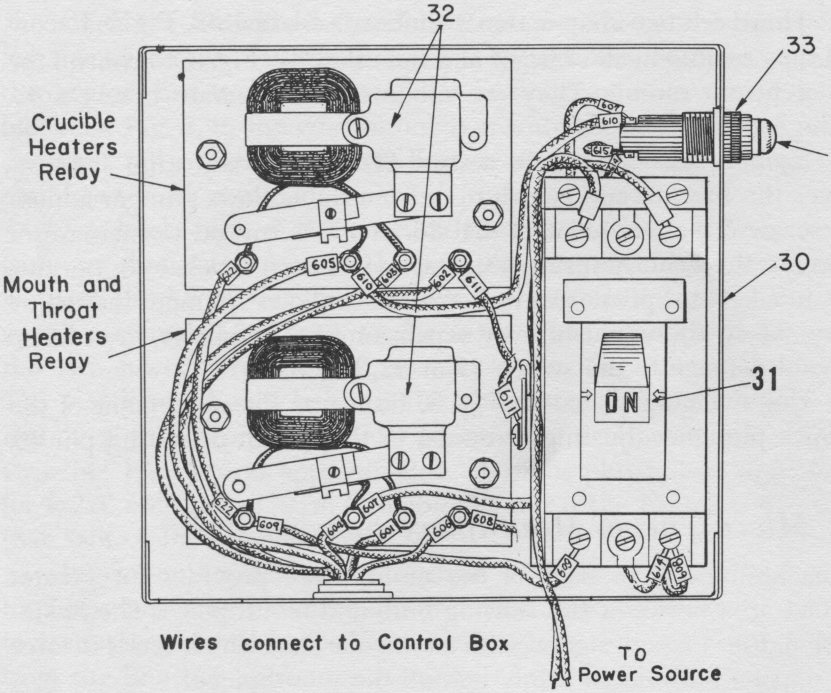

FIGURE 5—View of Comet Micro-Therm Electric Pot Relay and Circuit Breaker Box

downward by an electro-magnet to the stationary contact.

The sensitive snap-action switch 41, 42, Fig. 3, controls the small current passing through the coil of the magnet. When the snap-action switch closes, this magnet coil is energized and draws the silver contact on the arm down to the stationary contact, allowing the current to flow through the heaters. When the snap-action switch opens, the relay coil is deenergized and the contacts are drawn apart shutting off the current to the heaters.

The relay has two springs—the finger spring and the adjustable heel spring. Both of these springs are adjusted at the factory and normally should require no further attention. The heel spring determines the pull-in point of the relay and is set at the factory so that the relay will pull in at 80 percent of the rated voltage of the relay. The finger spring determines the drop-out point of the relay.

The D. C. relay operates on the same principle but in this case there are four pairs of contacts and the heater current is broken

simultaneously at four points. This prevents any destructive arc from burning the contacts.

Relays are designed to meet specific requirements and if necessary to replace a relay, care should be exercised to order the correct relay for the electrical characteristic of the power source. The relay is mounted in the relay box on the mold-gear arm by means of two screws, two thick fiber washers and two small lock washers. Also in the relay box in addition to the two relays 32, Fig. 5, is a circuit breaker 31 to provide voltage overload and over-temperature protection, and two neon indicator lights.

The Mouthpiece Temperature Control

The theory of operation for the mouthpiece temperature control is the same as described for the crucible temperature control. The mouthpiece temperature for normal operation is 500 degrees F.

Circuit Breaker Overload and Over-Temperature Protection

To prevent the pot from being damaged by overheating and to prevent excessive current flow in the electrical circuit, adequate protection has been provided.

A two pole, single throw, circuit breaker 31, Fig. 5, has been incorporated with the master power switch to provide this protection. The poles are connected together, and are both closed or both open; thus they are single throw.

There are two coils incorporated in the circuit breaker, one for over-current and one for overheat. See Fig. 7.

The series coil is connected in one leg of the circuit breaker and always carries the entire load of the pot current. If the current becomes excessive, the magnetic force of the coil becomes strong enough to trip the breaker.

The shunt trip coil is connected to the load side of the other leg of the circuit and normally carries no current. It is connected in series with the Klixon over temperature switch.

When the Klixon over-temperature switch, attached to outside of crucible, is closed, due to excessive temperature of the pot, the shunt trip coil is energized and trips the breaker. Because it is con-

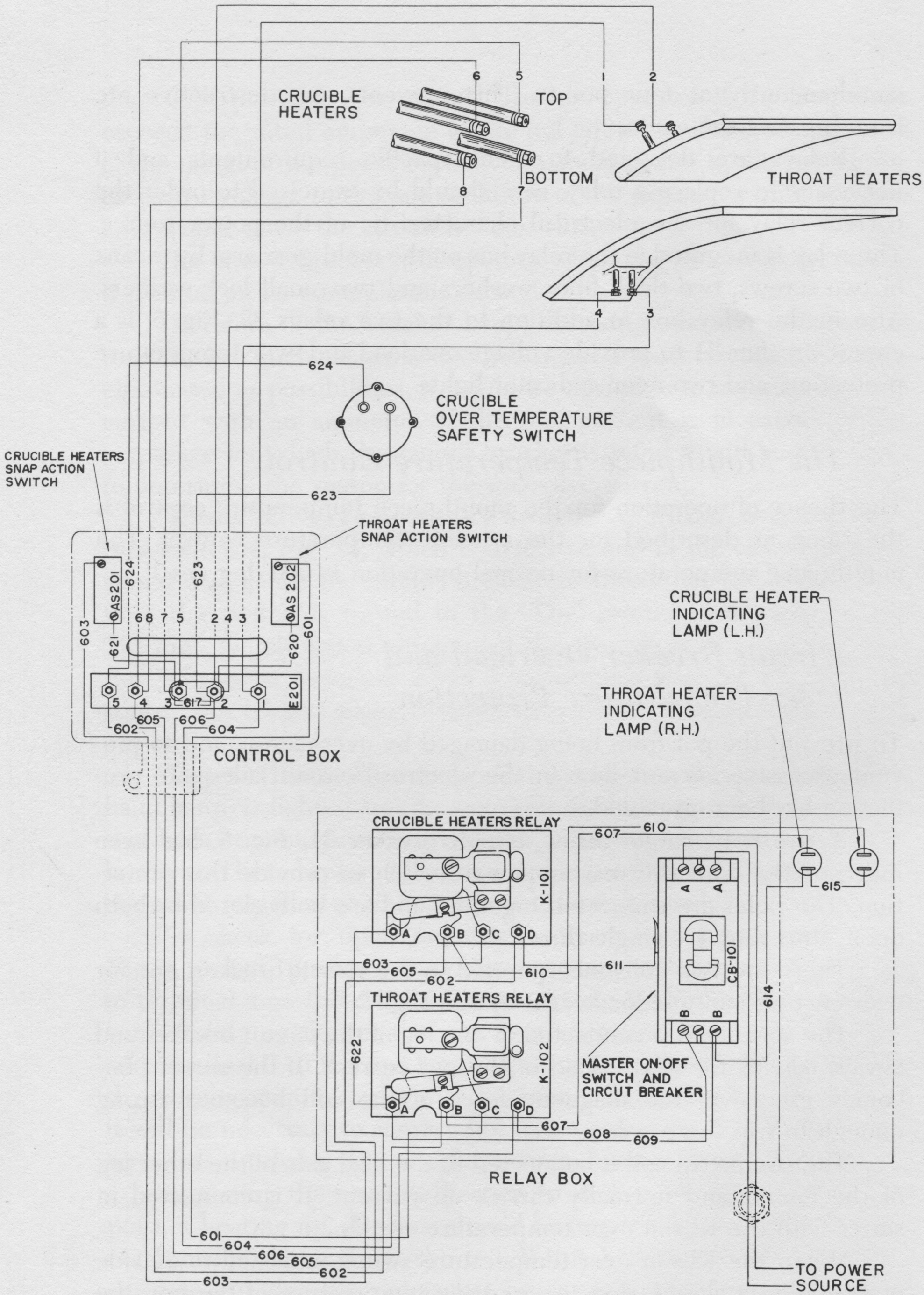

FIGURE 6—Comet Micro-Therm Electric Pot Wiring Diagram

nected to the load side of the breaker it is immediately deenergized when the breaker trips and therefore only carries current momentarily. For this reason the shunt trip coil is independent of the pot rating. On the other hand, the series coil must conform to the current of the circuit.

The "Klixon" switch is a normally open switch and therefore no current is flowing in this circuit. This switch is composed of a bimetalic disk which will close by a deflecting action when a certain pre-determined maximum safe temperature is reached.

Schematic wiring diagram, Fig. 7, shows how the system works. When the maximum safe temperature is exceeded the "Klixon" switch will close and the circuit breaker shunt trip coil will be energized, thereby tripping the breaker and opening the circuit.

The Indicating Lamps

Two indicating lamps form part of the Micro-Therm Temperature Control. These are located in the relay box, Fig. 5, and face the operator. The lamps indicate whether the relays 32, are open or closed. When lighted they indicate that the relays are closed and that current is flowing into the crucible and throat heaters. This does not necessarily mean that the heaters are getting hotter. If, for instance, these heaters

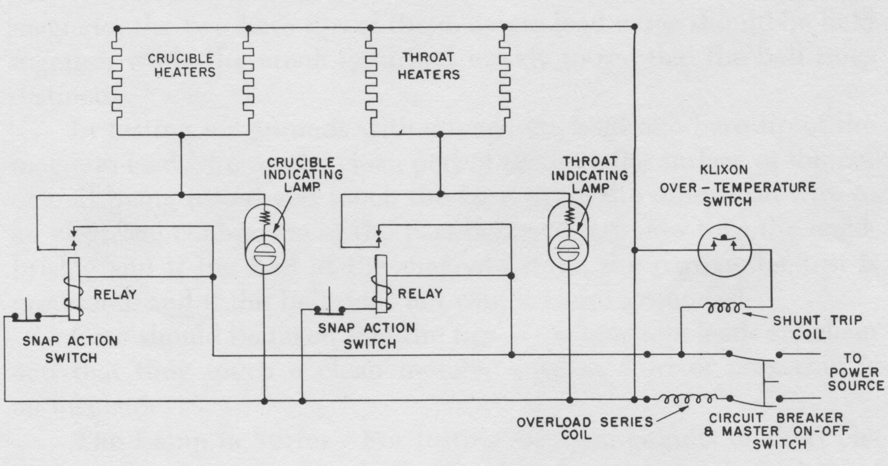

FIGURE 7—Comet Micro-Therm Electric Pot Schematic

are grounded out, the indicator light will still light. As the crucible and throat heaters very seldom burn out, however, it can be assumed that when the lamps are lighted the metal in crucible and throat is getting hotter and when the lights are out that the metal in crucible and the throat is getting colder.

The lamp bulbs are 1/12 watt neon lamps with single contact bayonette bases. To remove a lamp bulb, unscrew the glass jewel, then press the bulb back into the socket and turn counter-clockwise about a quarter turn. The bulb can then be lifted out of the socket.

All neon lamps require a resistor in series with the bulb to prevent the current from becoming excessive when the bulb lights. These resistors form a permanent part of the sockets and never need attention. The 110 volt sockets contain a 30,000 ohm resistor and the 220 volt sockets contain a 100,000 ohm resistor. The voltage is stamped on the base of each socket and in replacing a socket, care should be taken to see that a socket for the correct voltage is used. The same light bulb is used for all circuits.

Wiring Diagram

As can be seen in wiring diagram, Fig. 6, the electrical circuit is comparatively simple. It is the same for all voltages and for A.C. and D.C., with only some circuit components changing to meet specific electrical characteristics.

5. Lino-Therm Heaters

The Linotype Electric Pot operates on the basic principle of heat from within. Many years of practical usage plus continuous comparative research have proven beyond question the superiority of this method. Lino-Therm Crucible Heaters are immersed in the metal, thus all the heat generated is immediately transmitted to the metal, avoiding loss by conduction.

Lino-Therm Heaters (see Fig. 8) embody many desirable features, such as rugged construction and less possibility of failure due to short circuits or other injuries resulting from rough handling, overheating or other causes. Each heater consists of a length of steel tubing enclosing a length of spirally wound nickel chromium resistance wire which is surrounded by a special insulation of magnesium oxide. This insulation protects the resistance wire from contact with the outer steel protecting tubing. Terminals are fastened to the ends of the resistance wire in such a manner as to insulate them from the steel tubing and to seal the ends to prevent leakage of the magnesium oxide. Since this outside protective covering consists of a seamless steel tube, there are no joints to open up under accidental overheating. Lino-Therm Heaters are, therefore, very rugged and long lived.

Crucible Heaters

There are four heaters employed in the Comet Type Pot. Two are immersed directly in the metal and partially surround the pump well. These are the crucible heaters 14 and 15, Fig. 9. Heating by direct contact with the metal inside the crucible increases the efficiency of the equipment and the expansion bulb 25 being immersed in the metal adjacent to the heaters and pump well permits a very close temperature regulation. Since the metal is heated uniformly from within the crucible and since the heaters extend the full height and pass through the top of the metal, a high temperature can be applied at the start and the metal can be quickly reduced to a fluid state without possibility of cracking the crucible.

When the metal begins to heat, it is that portion in direct contact with the heaters which first becomes molten. Internal pressure is relieved by this melted pathway and the molten metal flows to the top. To aid in this relieving of internal pressure, when heating up a cold pot, the Lino-Therm Heaters are specially wound at the point where they pass through the top of the metal. This produces more heat at the surface of the metal, forming a melted pathway to relieve the internal pressure.

Metal in the crucible should always be kept at the correct level to completely cover the crucible heaters. (Level of metal should be one-half inch below inside rim of crucible.) The Lino-Therm Crucible Heaters are not designed for operation in air, and continued exposure to air will cause them to burn out or ground. As shown in Fig. 9, the terminals of the crucible heaters are brought out to a protected space underneath the pot cover. They pass through an opening in the splash guard and the terminals are held rigidly in place on the clamp bracket 18. A formed piece of sheet asbestos is placed over the terminals and glass wool is packed around the terminals to prevent metal reaching the terminals and causing a short in the event of the pot crucible being over-filled with type metal.

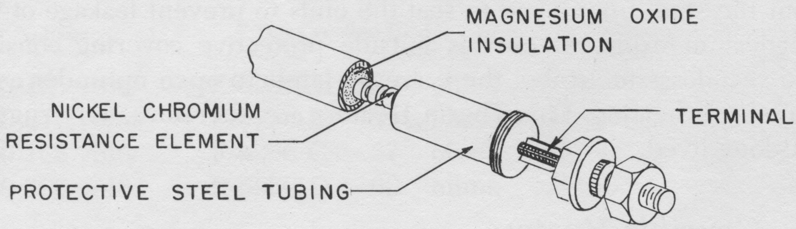

FIGURE 8—View of Section of Lino-Therm Heater

Upper and Lower Throat Heaters

The Lino-Therm Tubular Heaters are cast in aluminum blocks to provide better heat distribution (see Fig. 10). The crucible throat outer surface has been designed to provide as positive a contact with the heater blocks as possible. Protruding from the heater blocks are two stud type terminals. The throat or lower heater block has a power rating of 750 watts and the upper or mouth heater block 6, has a

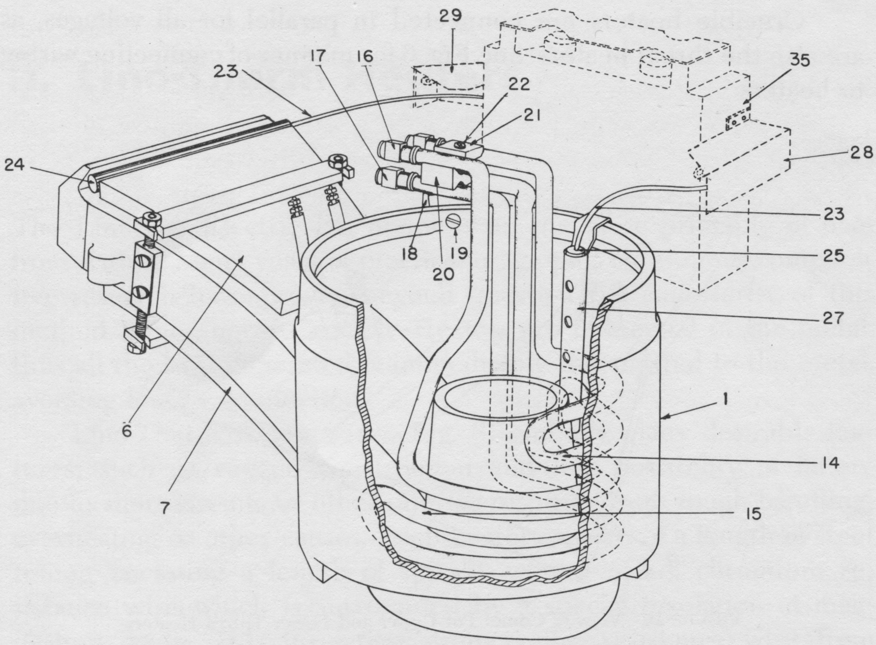

FIGURE 9—View Showing How Lino-Therm Heaters are Mounted on Comet Pot

power rating of 500 watts. Fig. 12 shows the heater blocks attached to the crucible throat. The heaters are held in place by the bolts 8 (tapped on each end) passing through the straps 9, and secured by the nuts 10. The lower end of the lower heater is clamped in place by screw 12.

Heater Electrical Data

Lino-Therm Crucible Heaters are available in 4 voltage ranges and throat heaters are available in 5 voltage ranges. See Table 1 for complete range of voltage and resistances.

The same heaters may be used on either A.C. or D.C. but since the Lino-Therm Heaters are made for one specified voltage range, they must be replaced by appropriate heaters if the line voltage is changed more than plus-minus 10 percent of their rated voltage. Heaters will usually operate satisfactorily if voltage variation is not greater than plus-minus 10 percent of their rated voltage.

Crucible heaters are connected in parallel for all voltages, as are also the throat heaters. See Fig. 6 for manner of connecting wiring to heaters.

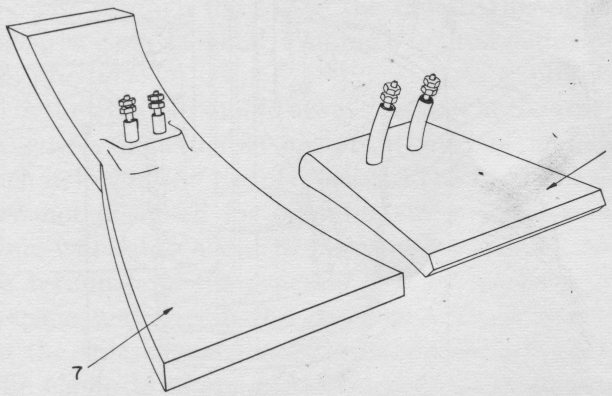

FIGURE 10—View of Comet Pot Upper and Lower Throat Heaters

CRUCIBLE HEATERS

Voltage	Top Crucible Heater Part No.	Top Crucible Heater Resistance	Bottom Crucible Heater Part No.	Bottom Crucible Heater Resistance
100-125 volts	F-6956 A	20 ohms	F-6957 A	20 ohms
200-250 volts	F-6956 B	80 ohms	F-6957 B	80 ohms
140-165 volts	F-6956 C	37 ohms	F-6957 C	37 ohms
180-200 volts	F-6956 D	60 ohms	F-6957 D	60 ohms

THROAT HEATERS

Voltage	Upper Throat Heater Part No.	Upper Throat Heater Resistance	Lower Throat Heater Part No.	Lower Throat Heater Resistance
100-125 volts	F-8437 A	25.8 ohms	F-8438 A	17 ohms
221-250 volts	F-8437 B	103 ohms	F-8438 B	68.8 ohms
140-165 volts	F-8437 C	43 ohms	F-8438 C	28.8 ohms
180-200 volts	F-8437 D	67.5 ohms	F-8438 D	45 ohms
200-220 volts	F-8437 E	81.7 ohms	F-8438 E	54.4 ohms

NOTE: Resistances given are for when heaters are at room temperature. Hot resistance is approximately 110 percent of cold resistance. Resistances given are approximate and may vary within plus-minus 10 percent of figures given without noticeably affecting operation.

TABLE 1

6. Maintenance and Testing

Testing Methods and Equipment

Few interruptions to continuous operation of the Linotype Comet Type Electric Pot are likely to occur, but any abnormal condition that might develop will be described with the proper remedy.

The main electrical troubles that may be found are "open", "grounds", or "shorts". Before doing any work on any part of the electrical equipment, always turn power switch to the "Off" position.

When disconnecting any wiring, in case identifying number or color is not distinguishable, label each wire and its corresponding terminal clearly so that it may be correctly replaced.

The equipment necessary to make all electrical tests is inexpensive and easily obtainable. The simplest method is to use a magneto when testing for grounds and a lamp in series when testing for opens and short circuits. A low reading Ohmmeter (0 to 1000 ohms) for measuring resistance and a voltmeter would be a more positive method of testing for short circuits, and the voltmeter reading would assure that correct voltage is reaching the pot heaters.

The Magneto – A hand-operated magneto is a very useful instrument for checking out the electric pot circuit. Before testing with a magneto, the two bare tips of the magneto lead wires should be held together while the crank is turned briskly to see that the bell rings distinctly.

In testing for grounds with a magneto, hold one bare tip of the magneto lead wire on the clean part of the metallic surface of the pot or unit being tested and touch the bare tip of the other lead wire to an electrical connection of the part being tested; now turn the crank briskly and if the bell of the magneto rings, the part under test is grounded, and if the bell does not ring it is not grounded.

Care should be taken that the tips of the magneto leads are clean and that they touch a clean metallic surface. Dirt or corrosion is an insulator.

The Lamp in Series – For testing for open circuits or short circuits, a lamp in series is the least expensive and simplest piece of testing equipment. See Fig. 11. It may readily be made from an in-

candescent lamp of your regular voltage, a keyless lamp socket, a convenient length of ordinary lamp cord and an attachment plug.

Connect the lamp cord to the attachment plug and the keyless socket in the ordinary way; then cut one of the two strands of the lamp cord a few inches from the lamp socket. Remove the insulation for one inch from the two ends of this strand of the lamp cord and twist the wires tightly.

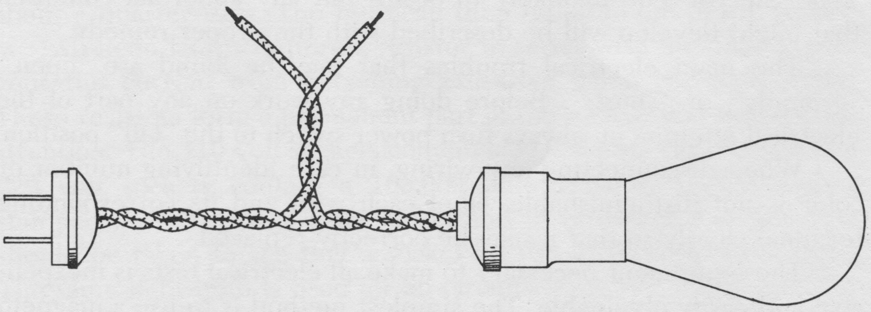

FIGURE 11—View Showing Test Lamp

Before making a test with this equipment, screw the lamp firmly into the socket, connect the attachment plug to a convenient outlet and touch the two bare tips of these wires together. The lamp should now light.

When testing for opens, connect the two bare lamp cord wire tips to two different electric terminals of the unit under test. If the lamp lights, it indicates that there is no open in the circuit of the unit. When making the above test all interconnecting wires to the units being tested must be disconnected and power shut off.

The Ohmmeter—When using the ohmmeter for checking for grounds the component being tested is completely disconnected from the remainder of the circuit. *All current should be turned off.*

Then one ohmmeter test lead is connected to the wire lead or terminal of the element being checked, and the other test lead is touched to a clean metallic surface adjacent to the component being tested. If no ground is existent the ohmmeter reading will be infinite. (No reading). If there is a ground an ohmmeter reading somewhere between 0 and infinity will be evident (depending on the ground condition).

To check for continuity of circuit components, connect the ohmmeter test leads across the wire lead or component being checked. If there are no breaks in the circuit there will be zero resistance reading. A break of continuity will, of course, show as a large resistance reading or an infinite resistance.

Switches are checked by connecting ohmmeter across terminals. A closed switch should show 0 resistance; an open switch should show infinite resistance.

Pot Will Not Heat Up

See that power switch 31, Fig. 5, is in the "On" position. If current is entering the relay box, the crucible indicating lamp should light. This lamp is wired across the two Lino-Therm Crucible Heaters and it will only fail to light if it is burnt out, or the crucible relay is in the open position. If no current is passing through the relay contacts the circuit to the heaters is open and, therefore, no current will be flowing to the indicating lamp.

Switch—If the pot fails to heat up it may be due to a snap-action switch 42, Fig. 3, which is failing to snap closed when the pressure on the plunger is relieved by the contraction of the expansion bellows.

Bulb and Bellows—It may also be that the bulb and bellows 23, Fig. 9, is defective and over-expansion of the bellows 53, Fig. 3, has resulted in the switch plunger 56 being held in the "Off" position.

Binding Plunger—The adjustable plunger 54 which projects between the expansion bellows 53 and the swinging plate 46 may also be binding in the D-shaped hole in the bellows housing mounting plate 51. This could cause the snap-action switch pin plunger 56 to be held in the "Off" position.

Improper Relay Action—Failure of the pot to heat up when the power switch 31, Fig. 5, is on may also be due to the relay 32 not closing properly to complete the circuit to the heaters. Relay closing action should be observed to be certain contacts are touching firmly together and the contact points are clean. To check relay in order to see if current is flowing through the contacts to the heaters connect a voltmeter across terminals B and C of the relay when the contact arm is down, Fig. 6.

Circuit Breaker—The circuit breaker feature incorporated in the master power switch 31, Fig. 5, may also be a reason for the pot failing to heat up, due to the circuit breaker throwing the switch to

the "Off" position. The circuit breaker operates if the amperage exceeds the rated amperage of the pot circuit or if the temperature of the metal in the pot is excessive. A short circuit in the pot wiring, excessive voltage to the pot, or failure of the expansion bulb and bellows would cause the circuit breaker throw-out action.

The circuit breaker will operate when the amperage for which it is rated on its nameplate is exceeded.

Therefore, if the breaker keeps throwing open for no apparent reason when such causes as overheating and short circuits have been eliminated as possibilities, it would be advisable to measure the line current with an ammeter. If the line current is in excess of the amperage for which the circuit breaker is rated it will be necessary to determine the reason for the excessive current.

"Klixon" Over-Temperature Switch—A "Klixon" over-temperature switch 4, Fig. 13, which is defective and in the closed position would also cause the circuit breaker to throw out the switch each time the switch is turned to the "On" position. To check on the "Klixon" switch action, disconnect the two wires 623 and 624 from the "Klixon" at terminals 2 and 5 on terminal strip 50, Fig. 3, in the control box 35 and observe action with the over-temperature switch out of the circuit.

"Open" Heater Elements—If the crucible indicating lamp (left-hand lamp) is lighted and the pot does not heat up, it is an indication that both crucible heaters are "open". This is an unusual occurrence, however. These heaters are connected in parallel and if one is "open", the other is sufficient to heat the pot, though slowly.

To check for open crucible heaters, turn power switch 31, Fig. 5, to "Off" position. Disconnect the two heater wires which come to terminal 4 on the crucible terminal strip 50, Fig. 3. Then with the lamp-testing outfit test the continuity between each of these wires and terminal 3. If the test lamp does not light, the heater attached to that wire is open. In order to determine which heater is the open one it will be necessary to remove pot jacket cover and test at the heater terminals. In doing this, remove terminal wires from heaters.

In testing the crucible heaters to determine the reason for the pot not heating up, all wires should be inspected to see that they are not broken and have not shorted. If it is found necessary to replace any wires under the pot jacket cover, only nickel wire should be used. Copper wire will not stand up due to the heat.

The Pot Heats Slowly

This may be caused by only one heater functioning.

All Lino-Therm Crucible Heaters, whether for 110 or 220 volt current, are connected in parallel. One heater may be in good condition and the other heater open. One heater will melt the metal in sufficient quantity to operate at ordinary speeds casting small slugs, but will require nearly three times the normal length of time to heat up.

Use of an Ohmmeter for Testing—If a low reading (0 to 1000 ohms) ohmmeter is available, the heaters can be tested for "opens", "shorts", and "grounds" with it. CAUTION: Never touch ohmmeter leads to a live circuit; power switch should be in "Off" position.

Testing for Grounds—To test for "grounds," touch the point of one of the ohmmeter test leads to any clean, unpainted spot on the pot and touch the point of the other test lead to the terminals of the heaters and to the five terminals in the crucible temperature control box, Fig. 3. The ohmmeter should show no reading (infinite resistance) if there are no grounds in the circuits.

Testing for "Shorts" and "Opens"—To test for "shorts" and "opens" in the crucible heater circuit touch one of the ohmmeter test leads to terminal No. 3 on the terminal strip 50, Fig. 3, and the other lead to terminal No. 4 on the terminal block. If the ohmmeter reads infinite resistance the crucible heaters or their external circuit may be open or burnt out. If the ohmmeter reading varies more than approximately 10 percent of the figures listed below, the heater circuit may be "grounded," "shorted," or "open."

The resistance reading for Lino-Therm Heaters and circuits tested as stated above should be approximately as shown below, subject to standard electrical resistance tolerance. The resistances shown below *are for both heaters in parallel, and when heaters are at room temperature.* When heaters are hot, resistance may vary upward as much as 10 percent depending on temperature.

	Crucible Circuit
100-125 Volts	10 ohms
140-165 Volts	19 ohms
180-200 Volts	30 ohms
200-250 Volts	40 ohms

Checking Individual Crucible Heaters—The method of checking the heaters as described above is a quick way of determining if the heaters are to blame for a slow-heating pot since the terminal block 50, Fig. 3, in the control box is readily accessible. However, it does not tell which of the two heaters of the crucible heating unit may need to be replaced.

To check each of the crucible heaters individually with a test lamp, or ohmmeter, remove the pot jacket cover and disconnect the wires to the heater terminals. Then touch the test leads to the two upper terminals 16, Fig. 9, to check the upper crucible heater and the two lower terminals 17, to check the lower crucible heater. The test lamp should light, or the ohmmeter should read approximately 20 ohms plus-minus 10 percent for a 110 volt Lino-Therm Crucible Heater and approximately 80 ohms plus-minus 10 percent for a 220 volt Lino-Therm Crucible Heater if the heater is all right. (See table 1 for complete list.)

Improper Adjustment of Control—Slow heating may be caused by improper crucible temperature control adjustment, for if the temperature control keeps disconnecting the crucible heating units from the line before the temperature of the metal has reached 535 degrees F., the metal will not reach proper operating temperature.

Abnormally low voltage may also cause the pot to heat slowly. If the voltage of the line is 15 percent less than the voltage of the pot, it would require about 20 percent longer time to bring the metal to operating temperature.

Checking Supply Voltage—The supply voltage can be tested with a voltmeter. Use either an A.C. or D.C. meter depending upon current supply and make sure voltmeter reads above voltage to be checked. Touch the two voltmeter leads to two upper terminals on the power switch 31, on the relay box, Fig. 5. This will give supply voltage reading. Check the voltage with all heaters on and then with all heaters off. A voltage drop below the minimum voltage for which the heaters are rated when the heaters are turned on is an indication that there is an excessive voltage drop in the supply lines and it might be necessary to install heavier supply lines, or provide a voltage booster.

It is a good plan to take a voltage reading every hour or so during the first day after electric pots have been installed to check on the possibility of voltage fluctuation in the supply lines. A check should

be made with the Public Utility if this fluctuation exceeds plus-minus 10 percent to see if this condition can be corrected.

The Pot Overheats

For the pot to overheat a number of things must happen to the circuit before a dangerous overheating can take place.

First of all the snap-action switch must remain closed or the relay must remain closed. For the snap-action switch to remain closed it would either have to be defective, or be fused closed by excessive current passing through it—which would indicate that something is also wrong with the circuit breaker, since it is the function of a circuit breaker to trip open when excessive current passes into it.

The plunger screw 54, and lock nut 55, Fig. 3, may also be preventing the plunger actuated lever 46 from opening the snap-action switch 42, by arresting the travel of the lever too soon, due to the plunger screw 54, binding in the D-shaped hole in the bellows mounting bracket 51.

The relay may stick due to gumminess, dirt, or corrosion binding the clapper hinge pin in the closed position.

The snap-action switch mounting bracket may also be binding due to corrosion or dirt so that the switch is held out too far from the plunger.

The bulb and bellows may also be reacting sluggishly due to overheating. In this case it will be necessary to replace the unit.

If either the snap-action switch or the relay remain closed the pot will continue to heat up until the pot has reached a temperature of about 600 degrees F. At approximately this temperature the "Klixon" switch 4, Fig. 13, will snap closed, energizing the shunt trip coil wired in series with it and tripping open the circuit breaker. If it happens that the "Klixon" does not close, the current will continue to flow. If the "Klixon" has closed but the circuit breaker is faulty, and does not open, current will also continue to flow.

Since it is improbable that the snap-action switch or relay and the "Klixon" or circuit breaker would become defective at the same time, excessive overheating of the pot is not very likely to happen.

The circuit should be checked immediately after the circuit breaker has been tripped open. The circuit breaker will continue to

trip open as long as the trouble that had caused the breaker to open remains uncorrected.

If the trouble was caused by overheating, the circuit breaker cannot be closed until the "Klixon" switch has reopened, which is at a pot temperature of approximately 520 degrees F. This should immediately indicate that the snap-action switch has not opened the cricuit and a check at this time is necessary. After the elimination of the cause for the overheating, or overload of the circuit, the circuit breaker can be closed by snapping the manually-operated "On-Off" switch on the relay box to the "On" position.

Checking the Circuit Breaker—To check the circuit breaker in order to determine that it will function properly when the "Klixon" closes or a short or ground in the heater circuit occurs, touch a heavily insulated piece of wire (exercising caution) between terminals 2 and 5 of the terminal strip 50, Fig. 3, in the control box. This creates the same situation as the "Klixon" closing, which should result in the circuit breaker immediately opening to disconnect the circuit from the power source.

Mouthpiece Gets Too Hot

The temperature of the throat heaters, which maintain proper temperature of the metal in the crucible throat and mouthpiece area, is regulated by the mouth and throat heat control dial 36, Fig. 3, at the right on top of the control box.

Ordinarily this dial is kept at the neutral position but if the mouthpiece is too hot the dial should be turned counter-clockwise to decrease the temperature. If mouthpiece is too cold the dial is turned clockwise to increase the temperature.

The position of the dial predetermines the temperature at which the throat heaters will operate to maintain proper mouthpiece heat. The operation of the mouthpiece bulb and bellows in conjunction with the snap-action switch, relay, and the throat heaters, keeps the mouthpiece at the temperature selected.

If the mouthpiece temperature is excessive and cannot be controlled by adjusting the throat heater control dial it may be due to a defective snap-action switch or expansion bulb and bellows, or both. When replacing a bulb and bellows expansion unit it is good maintenance practice to replace the snap-action switch at the same time.

A relay which is not functioning properly might also cause overheating of the mouthpiece since it may not be opening the circuit to the throat heaters when the temperature exceeds the selected operating point.

If by chance the temperature of the mouthpiece becomes excessive the expansion bulb and bellows unit may be permanently injured and lose its control facilities. If such is the case the bulb and bellows unit must be replaced.

Throat Heaters Will Not Heat Up

The throat heater circuit is separate from the crucible heater circuit and is controlled by the snap-action switch 41, Fig. 3. Both throat heaters are connected in parallel so that if one burns out, the other will continue to heat the throat and mouthpiece area, though slowly.

As described under heading "The Pot Will Not Heat Up" make sure that the line current is entering the crucible control box. If the indicating lamp is lighted, current is entering the control box.

When the throat heater indicating lamp (the right one) is lighted, it is an indication that the throat heater snap-action switch 41, and relay 32, Fig. 3, is closed and passing current to the upper and lower throat heaters. If the lamp is lighted and the mouthpiece will not heat up, both throat heaters are "open", an unusual occurrence since they are connected in parallel and the failure of one heater would still permit the mouthpiece to heat, though slowly.

Checking Both Throat Heaters in Parallel—To check on the possibility that both throat heaters are open, turn power switch 31, Fig. 5, to the "Off" position and disconnect leads 604, 606, 617, 620 and 621 from terminals 1 and 2 of terminal strip 50, Fig. 3, in the control box. Then with a lamp-testing outfit or ohmmeter check across terminals 1 and 2 of the terminal strip 50, Fig. 3. If both heaters are "open" the lamp will not light or the ohmmeter reading will be infinity. The resistance reading of the ohmmeter should not vary more than plus-minus 10 percent of the figures listed below, *which is for both throat heaters in parallel and at room temperature.*

	Throat Circuit
100-125 Volts	10 ohms
140-165 Volts	17 ohms

180-200 Volts	27 ohms
200-220 Volts	33 ohms
221-250 Volts	42 ohms

Checking Individual Throat Heaters—To check each of the throat heaters individually the test lamp or ohmmeter can be used. The two inspection covers which permit access to the heater terminals are removed. The inspection cover for the top throat heater is located on top of the pot jacket cover. The inspection cover for the lower throat heater is located under the throat of the pot and access to it can be had by pulling out the mold slide.

Remove leads from heater terminals and place a test lead on each terminal. If the resistance of each heater varies more than plus-minus 10 percent of the figures indicated on table 1, or if the test lamp does not light, the heater being tested should be replaced.

Temperature of Metal Fluctuates

The Micro-Therm crucible temperature control unit ordinarily will operate when the temperature of the metal changes. When the metal temperature reaches the predetermined temperature, the expansion bellows will have expanded to open the crucible snap-action switch, which in turn will open the relay circuit. After the current has been disconnected from the crucible heaters, the temperature of the metal will rise very slightly due to heat conductivity of the metal.

When the temperature of the metal drops below the standard predetermined setting the expansion bellows will contract, allowing the snap-action switch to snap to the closed position. The relay will close and current will immediately flow through the crucible heaters.

In checking metal temperature in a Micro-Therm Electric Pot, always remove the Pot Pump Plunger and insert the thermometer in the plunger well. This will give an accurate temperature reading.

If the temperature of the metal fluctuates too much, it may be an indication that the crucible expansion bulb and bellows has been strained at some time due to overheating. This means that it is sluggish and will react slower to temperature changes. As the temperature of the metal rises, it will take longer for the expansion bellows to operate the mu-switch. Consequently, the variation in temperature of the metal will be greater than it should be. In such cases, the expansion bulb and bellows should be replaced.

Temperature fluctuations may also be due to variation in the power source due to loads applied by adjacent machinery exterior to the Linotype machine. If this is suspected, a recording voltmeter should be applied to the electric pot at the master power switch.

The Micro-Therm Bulb and Bellows

The bulb and bellows assembly for both crucible heat control and mouth and throat heat control is the same except for the bends in the connecting tube between the bulb and the bellows. This must necessarily vary to fit around the contours of the pot jacket and cover. When a replacement bulb and bellows assembly is shipped from the factory the tube is straight and the assembly may be used for either crucible or mouth and throat control by bending the connecting tube to fit whichever application is necessary.

Care should be exercised in handling and bending the connecting tube of this bulb and bellows assembly in order to avoid making sharp kinks in the tube. The diameter of the hole through the tube is very small and a sharp kink might result in closing up the hole so that proper flow of the fluid between bulb and bellows is prohibited.

When replacing a bulb and bellows assembly the temperature of the metal in the crucible should not exceed 505 degrees F. and bulb should be at room temperature or warmer before insertion in the metal. If possible, the crucible should be bailed out prior to applying a new bulb and bellows assembly. In this way, the new bulb and bellows can be applied to an empty pot and brought up to casting temperature gradually, thus protecting against sudden over-expansion of the temperature sensing assembly.

Opening of Circuit Breaker—Grounding

If the circuit breaker keeps throwing out when an attempt is made to close it, it may be that some part of the electrical circuit is grounded or short circuited and it will be necessary to locate and rectify this condition before resuming normal operation. The circuit breaker is designed to throw out and stop the flow of current to the pot heaters and control circuit if the amperage at the pot exceeds the value for which the circuit breaker is rated. This rating can be found on circuit breaker name plate.

Splashed metal is the cause of most grounds and while the heater terminals are protected against this, care should always be exercised in operating the equipment. Operating the pot with the molten metal above the rim on the inside of the crucible or dropping ingots of metal carelessly into the pot will splash the metal over the crucible walls into the heater insulation.

The wires in the crucible control box may be grounded, caused by a breakdown in the insulation. This will ground the pot. A slight ground on some parts of the pot will not prevent its satisfactory operation, but a heavy ground or short circuit will prevent its operation and throw the circuit breaker open.

7. Replacements

The following material concerns the replacement of those parts which may need maintenance attention after a normal period of usage. When disconnecting electrical wiring it is a good idea to tag each wire and corresponding terminal so that they can be correctly reconnected.

Crucible Heaters

It is seldom that both crucible heaters will be burned out at the same time. Since these heaters are connected in parallel for all voltages, one heater can be used to heat the metal preparatory to removing the burned out heater. If the defective heater is grounded, it must be disconnected from the circuit or it will continue to cause the circuit breaker to trip off.

To Remove—Either of the two crucible heaters 14, 15, Fig. 9, cannot be removed alone. Both heaters must be removed and replaced together.

Heat the metal to operating temperature and dip out the metal down to the crucible well. Then shut off current.

Remove two protecting guards 28, 29, Fig. 9. Then remove the pot pump stop safety bracket and the pot jacket cover. In order to remove the crucible bulb and bellows assembly it is necessary to take off the control box cover and remove the four screws 52, Fig. 3, which hold the crucible expansion bellows 53. The bulb and bellows assembly can then be removed. Remove the bulb guard 27, Fig. 9.

Disconnect wiring to heater terminals. Loosen and remove the clamp cap screw 22, Fig. 9, the clamp cap 21, and the clamp 20. With a pair of pliers, lift the two crucible heaters from the crucible, making sure that the heater terminals are not damaged. Immediately replace with a new heater or heaters before metal cools.

To Replace—Place the new heater with the old heater in the same position they occupy in the crucible and then place the two heaters in crucible. Replace heater clamp 20, Fig. 9, clamp cap 21, and clamp screw 22, connect insulated wires to heaters. Replace bulb guard 27, bulb and bellows assembly, pot jacket cover, and protecting

guards 28, 29. Replace pot pump stop safety bracket. Metal temperature should not exceed 505 degrees F. when bulb and bellows assembly is replaced.

Throat Heaters

Both Throat Heaters 6, 7, Fig. 13, have been designed to permit their replacement without removing the crucible from the pot jacket. Turn off power when replacing either upper or lower throat heaters.

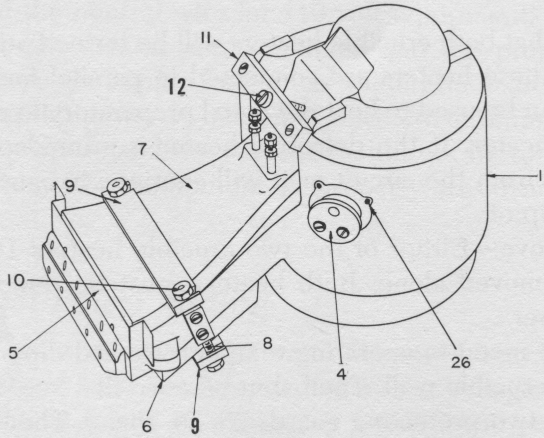

FIGURE 12—View Showing Method of Mounting Lower Throat Heater to Crucible

To Remove Lower Throat Heater—Open the vise and pull mold slide forward to expose the T-shaped cover under the throat of the pot. Remove the T-shaped cover. Take wire leads off heater terminals. Unscrew the two clamp nuts 10, Fig. 13, which hold clamp 9, across the heater. Loosen the threaded bolt 12, which holds the bottom of the heater firm. Slide heater out through the T-shaped hole in pot jacket.

To Replace Lower Throat Heater—Reverse procedure outlined above for the removal of this heater. Make certain that the heater fits snugly against the crucible throat before tightening clamp nuts.

When replacing clamp nuts apply a little compound made up of graphite and vaseline so that they can be removed readily.

If heater clamps are removed, note when replacing them that the distance between the holes in the clamp and the ends of the clamp vary in length. The end which is longest should be toward the top to facilitate assembly.

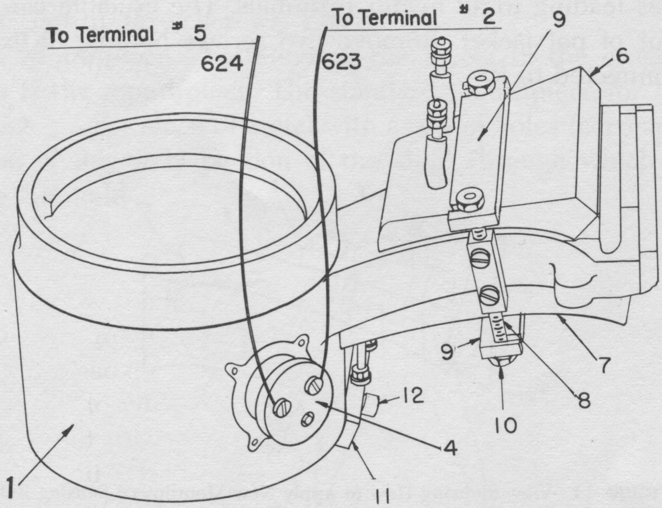

FIGURE 13—View Showing Method of Mounting Upper Throat Heater to Crucible

To Remove Upper Throat Heater—Remove the five screws holding the upper heater terminal inspection plate on, and lift off inspection plate. Disconnect the two wires to heater terminals. Unscrew the two clamp nuts 10, Fig. 13, which fasten the heater clamp 9 across the upper throat heater. Lift the heater out through the hole in the top of the pot cover provided for inspecting the heater terminals.

To Replace Upper Throat Heater—Reverse procedure outlined above for removing the upper throat heater, making certain that the heater is pushed well forward to assure good contact with the mouthpiece sensing bulb and that the heater fits snugly against the crucible surface.

"Klixon" Over-Temperature Safety Switch

To Remove the "Klixon" switch 4, Fig. 13, the crucible must be removed from the pot jacket. Remove pot pump plunger and pot pump stop bracket. Then turn off pot power switch and remove pot cover and expansion bulb and bellows. Allow pot to cool. Loosen all hard asbestos around crucible. Remove set screw in pot jacket throat, which is used to hold the crucible firm in the pot jacket. Disconnect the wires leading to all heater terminals. The crucible can then be lifted out of pot jacket. Remove two screws holding "Klixon" and wires connected to it.

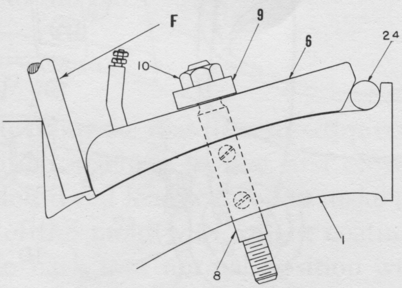

FIGURE 14 View Showing How to Apply New Mouthpiece Sensing Bulb

To Replace the "Klixon" over-temperature safety switch reverse procedure followed above, making certain that "Klixon" fits firmly to the crucible wall.

Crucible Heater Control Bulb and Bellows

To Remove and Replace—Heat metal in crucible to "operating temperature" and then turn power switch 31, Fig. 5, to "Off" position. Remove screw holding expansion tube guard 28, Fig. 9, to pot cover and remove screws holding guard 28 to control box. Next, remove pot cover and this will expose bulb inside of crucible. The bulb 25 is housed in a jacket 27 which is attached to crucible wall. Take control box cover off. The four screws 52, Fig. 3, holding bellows bracket 51 in place are now removed. Lift bulb and bellows from crucible.

Before replacing the bulb and bellows with a new unit make sure that this new unit has been exposed to room temperature (70 degrees F.) for at least one hour and that the metal temperature does not exceed 505 degrees F.

If possible, it is preferable to bail out the pot before applying a new bulb and bellows. This allows the temperature to be brought up gradually, thereby protecting against over-expansion of the expansion bellows and breakdown of the liquid in the bulb and capillary tube by too rapid heating.

Reverse procedure followed above to re-install bulb and bellows. To bend bulb and bellows connecting tube to fit, place sensing bulb in position in crucible and bend tube around contours of the pot until bellows housing fits in position in control box. If necessary to readjust the crucible temperature control, follow the directions as explained in section headed "Installation" sub-section "Adjusting Micro-Therm Temperature Control".

When replacing bulb and bellows assembly exercise care to avoid making extremely sharp kinks in the tube which connects between the bulb and bellows.

Throat Heater Control Bulb and Bellows

To Remove and Replace—Turn power switch to "Off" position. Remove upper heater inspection plate and loosen two clamp nuts 10, Fig. 13, holding upper heater 6 in place. Remove four screws 52, Fig. 3, holding bellows 53 in control box 35. Remove the jacket cover mouthpiece bulb guard 29. Push upper throat heater 6, Fig. 9, back and lift out expansion bulb 24.

When replacing bulb make sure it is centrally located behind mouthpiece. It is permissible to be slightly over on the left side, but never over on the right side; for if the bulb is over on the right side it will interfere with lock-up.

Referring to Fig. 14, a steel rod is placed behind mouthpiece heater and a moderate force F is applied to the rod to assure close contact between heater and bulb. Tighten clamp nuts while force is applied, for the mouthpiece heater will slip away from bulb if not held in place until nuts are securely tightened.

Replace inspection plate jacket cover, mouthpiece bulb guard, and replace bellows in control box.

Relay

To Replace Either Relay 32, Fig. 5, disconnect all wires from the four relay terminals. Remove the nuts, lock washers and fiber spacing washers from the two studs and pull the relay straight forward. In applying the new relay, reverse these steps and reconnect the wires to the four relay terminals.

To Replace the Relay Contacts—The relay should first be removed from the relay box. Remove the cotter pins, the cup washers and the finger springs. The upper contact can then be removed from the relay arm. The lower contacts are screwed in to the top of the brass posts and held in place with lock nuts. After the new contacts are in place the spacing between contacts must be carefully adjusted by raising or lowering the lower contacts. For the A.C. relay this space should be 3/16 inch. For the D.C. relay the space is 5/32 inch.

To Replace a Relay Coil—Remove the relay from the box. Remove the screw holding the name plate in place and remove the name plate and upper part of the armature by pulling out the bronze pin. Bend up the small soft metal strip which is folded down over the top of the coil. Disconnect the coil leads from the terminals. Pull the coil straight up.

Push the new coil down over the frame and see that it is tight. If necessary insert thin fiber (or plastic) spacing wedges between the coil and the frame. The coil should be firm and tight on the frame especially in A.C. relays or the relay will be noisy. Bend the soft metal piece back in place so that it lies flat along the top of the coil. Replace the armature and name plate and reconnect the coil leads to the relay terminals. Be sure the pole faces are clean.

The A.C. relay contacts normally do not require any attention. However, if the relay action becomes sluggish, the adjusting screw on the heel spring assembly may be turned to increase tension of the heel spring. Always check the relay action after any adjustment to be sure that the relay will close when the coil is energized.

Snap-Action Switches

To Remove and Replace—Allow metal to cool to below 520 degrees F. by turning power switch 31, Fig. 5, to the "Off" position. Remove crucible control box cover. Remove wires to snap-action switch 41 or 42, Fig. 3, and remove two switch-holding screws. Apply

new switch and reconnect wires. If necessary to adjust temperature control follow directions shown under section heading "Installation", sub-section "Adjusting Micro-Therm Temperature Control".

Wiring

The Micro-Therm Electric Pot is wired using the following types of wire.

All wires connected between heaters or "Klixon" and control box are:

No. 16 Standard Nickel Asbestos Insulated with double insulation on throat heater wires.

All other wiring consists of:

No. 14 Stranded Copper, Asbestos Insulated or

No. 18 Stranded Copper, Asbestos Insulated

Note: Do not substitute any other type wire under pot jacket cover but above mentioned No. 16 Stranded Nickel wire for most other metal wires will not stand up under heat it is subjected to.

Repacking of Pot

In repacking a pot "dry" asbestos must be used.

Pack well around the crucible about one-half inch below the top of the pot jacket, after placing a sheet of asbestos on each side of the crucible just back of the throat, to prevent the asbestos from falling into the "Klixon" switch and throat heater area. Make sure enough "dry" asbestos gets under the crucible and pot jacket to eliminate as much as possible the loss of heat through radiation. The crucible packing is then sealed in with a mixture of approximately four parts of asbestos to one part of cement, adding enough water to give the mass the consistency of putty. *Do not pack area around throat heater and "Klixon" switch.* Putting asbestos around the throat area would interfere with "Klixon" action and also removal of the lower throat heater through the inspection hole in the pot jacket would be hampered.

Index of Parts

Code No.	Part No.	Part Name
1	F-8662	Crucible and Mouthpiece, Assembled
2	F-8368	Pot Jacket
3	F-8447	Throat and Mouth Heater (Lower) Cover
4	F-8489	Over-Temperature Safety Switch (Klixon)
5	F-8448	Crucible Drip Guard
6	F-8437	Upper Throat and Mouth Heater (Specify Voltage)
7	F-8438	Lower Throat and Mouth Heater (Specify Voltage)
8	F-8434	Throat and Mouth Heater Clamp Stud
9	F-8433	Throat and Mouth Heater Clamp
10	F-8751	Throat and Mouth Heater Clamp Nut
11	F-2141	Throat Heater Clamp
12	F-2474	Throat Heater Clamp Screw
13	F-8448	Crucible Drip Guard
14	F-6956	Top Crucible Heater (Specify Voltage)
15	F-6957	Bottom Crucible Heater (Specify Voltage)
16		Top Crucible Heater Terminal
17		Bottom Crucible Heater Terminal
18	F-6951	Crucible Heater Clamp Bracket
19	F-6952	Crucible Heater Clamp Bracket Screw
20	F-6953	Crucible Heater End Clamp
21	F-6954	Crucible Heater End Clamp Cap
22	F-6955	Crucible Heater End Clamp Cap Screw
23	F-8904	Bellows and Bulb, Assembled
24		Mouthpiece Sensing Bulb
25		Crucible Sensing Bulb
26	G-121	Over-Temperature Safety Switch (Klixon) Screw
27	F-8449	Crucible Bulb Guard
28	F-8444	Bellows and Bulb Cover (Back)
29	F-8445	Bellows and Bulb Cover (Front)
30	F-8672	Relay and Circuit Breaker Box, Assembled
31	F-8647	On-Off Switch and Circuit Breaker (Specify Voltage)
32	F-8058 A.C. F-8059 D.C.	Relay, Assembled (Specify Voltage)

Code No.	Part No.	Part Name
33	**F-8202 110 Volt**	Indicating Lamp Socket, Assembled
	F-8205 220 Volt	
34	**F-8200**	Indicating Lamp
35	**F-8670**	Temperature Control Box, Assembled
36	**F-8486**	Mouthpiece Heat Control Dial
37	**F-7856**	Crucible Heat Control Dial
38	**F-8485**	Control Dial Adjusting Screw
39	**F-8674**	Control Dial Spring
40	**F-8498**	Control Dial Cover Plate
41	**F-7957**	Throat Heaters Snap Action Switch
42	**F-7957**	Crucible Heaters Snap Action Switch
43	**F-8669 (L.H.)**	Snap Action Switch Pivoting Bracket
	F-8668 (R.H.)	
44	**F-7187**	Snap Action Switch Pivoting Bracket Pivot Screw
45	**F-8490**	Snap Action Switch Pivoting Bracket Spring
46	**F-8483**	Snap Action Switch Bracket Swinging Plate
47	**D-1029**	Snap Action Switch Bracket Swinging Plate Hinge Pin
48	**I-681**	Snap Action Switch Bracket Set Screw
49	**E-3265**	Snap Action Switch Bracket Set Screw Lock Nut
50	**F-8663**	Control Box Terminal Strip, Assembled
51	**F-7217**	Expansion Bellows Mounting Bracket
52	**G-121**	Expansion Bellows Mounting Bracket Screw
53		Expansion Bellows Housing
54	**F-7210**	Expansion Bellows Plunger Adjusting Screw
55	**I-2800**	Expansion Bellows Plunger Adjusting Screw Lock Nut
56		Snap Action Switch Plunger
57	**F-8665**	Control Box Cover Fastener Spring

When Ordering Parts Always Give Pot Serial Number and Specify Electrical Characteristics of Power Source

LINOTYPE

MERGENTHALER LINOTYPE COMPANY
A Division of ELTRA Corporation
29 Ryerson Street, Brooklyn, New York 11205

AGENCIES

Atlanta 30313 —300 Luckie Street, N. W.

Boston 02116 —Park Square Building

Chicago 60605 —531 Plymouth Court

Dallas 75207 —1304 Dragon Street

Los Angeles 90015 —1212 Albany Street

New York 11205 —29 Ryerson Street, Brooklyn

San Francisco 94103 —155 Twelfth Street

IN CANADA

Canadian Linotype, Limited
829 Oxford Street, Toronto 18

LEADERSHIP THROUGH RESEARCH

Representatives in all Principal Cities

Printed in U.S.A. 720-13.2-J-Nn-2X